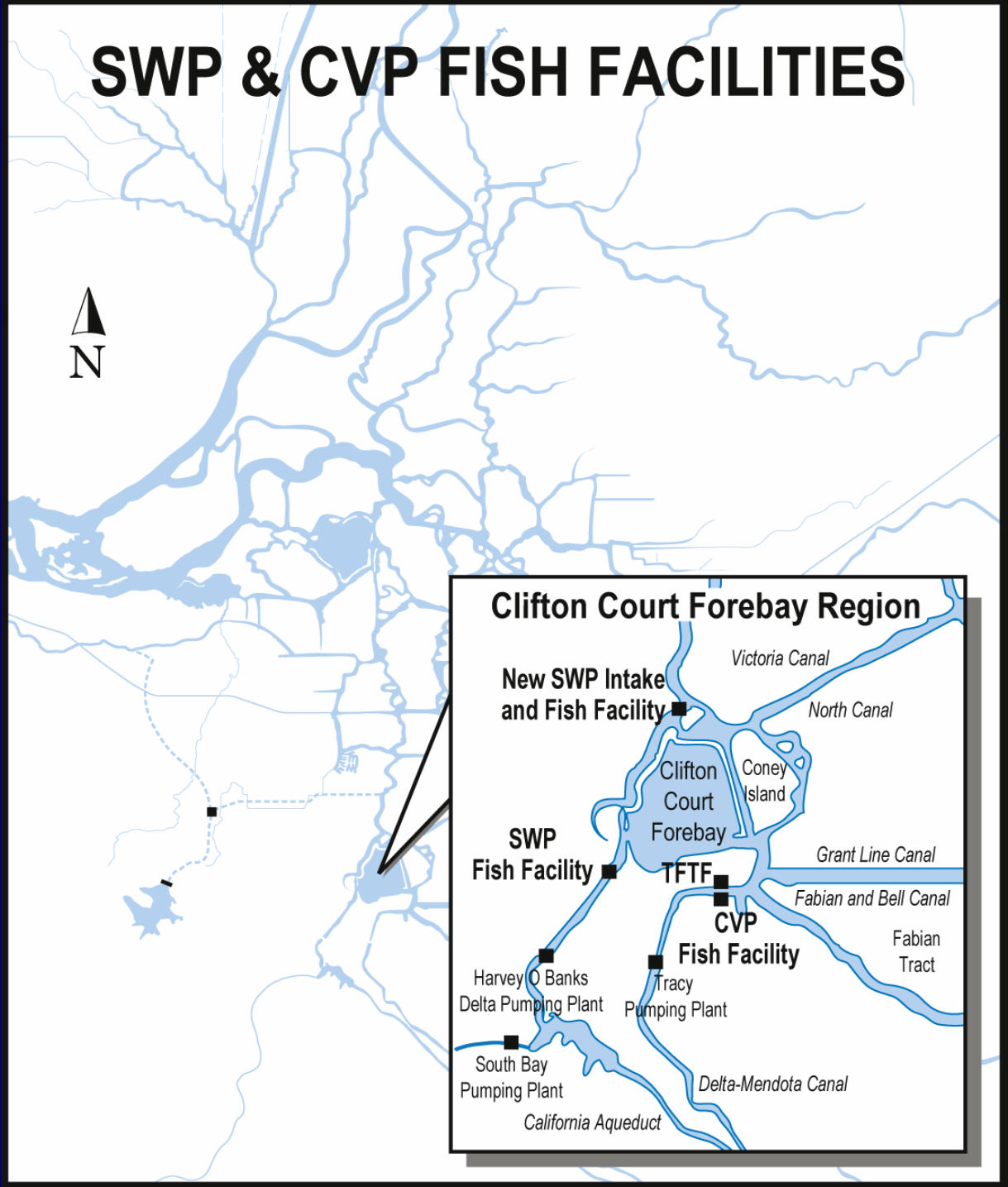
# SWP and CVP Fish Protective Facilities

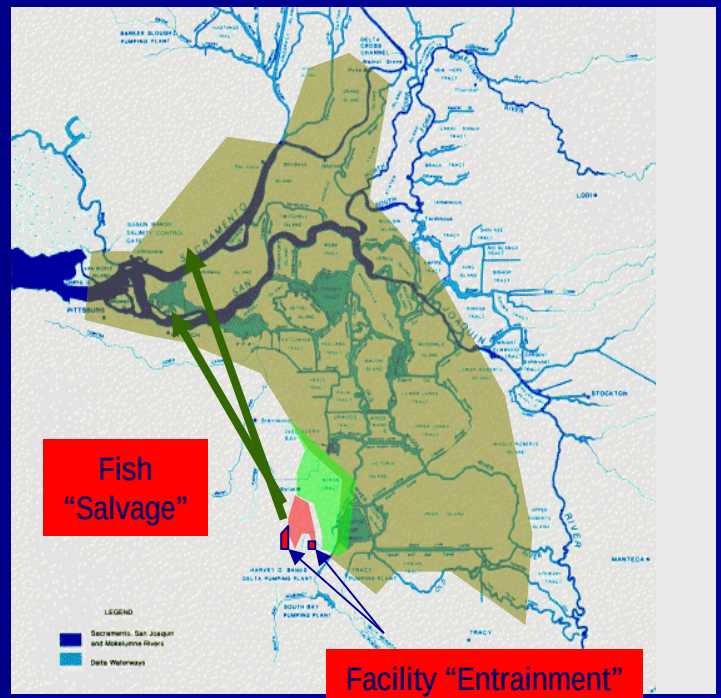
Darryl Hayes, P.E.
CBDA

# SWP & CVP FISH FACILITIES



# Fish Facilities Collect Fish that are Drawn to the Export Pumps

- Operated whenever export pumps are operating
- Fish are separated from exported water and bypassed into holding facilities
- Fish are transported and released in the western Delta, away from pumping influence
- About 15 million fish/year are diverted away from pumps and returned to the Delta alive
- Fish collection efficiency highly variable because behavioral system is used

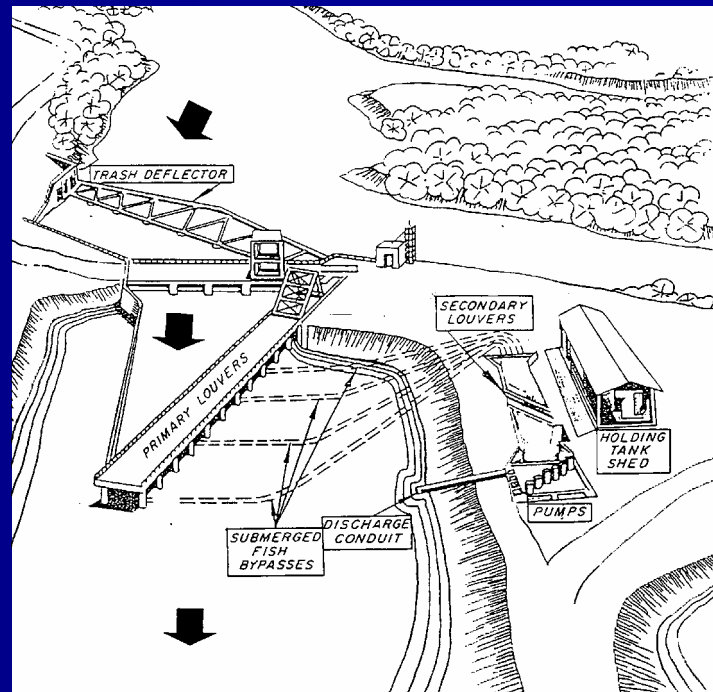



Skinner FF
Banks PP
Existing CCF Intake
Tracy PP
Tracy FF


CVP - Tracy Fish Facility

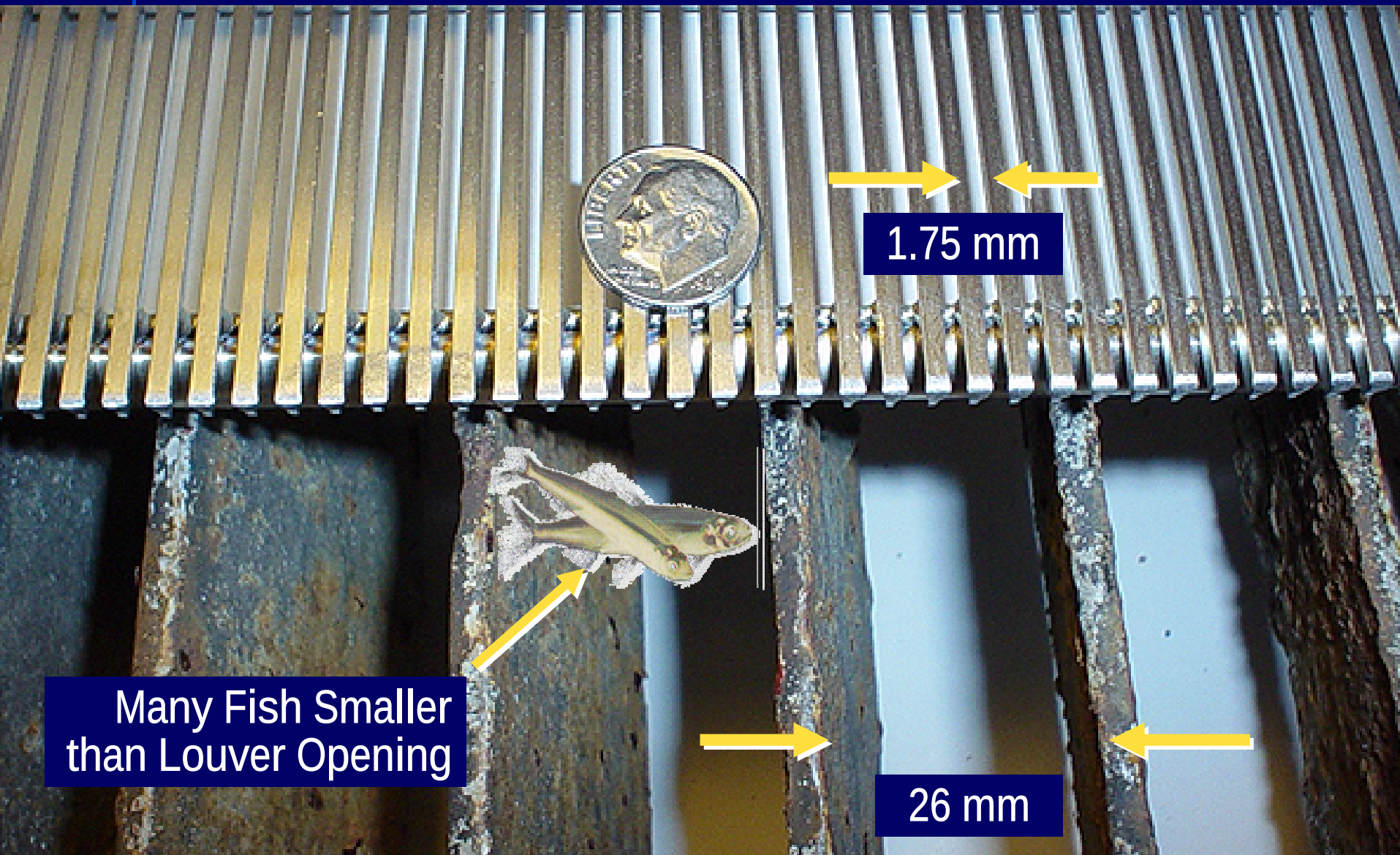

Tracy Fish
Facility

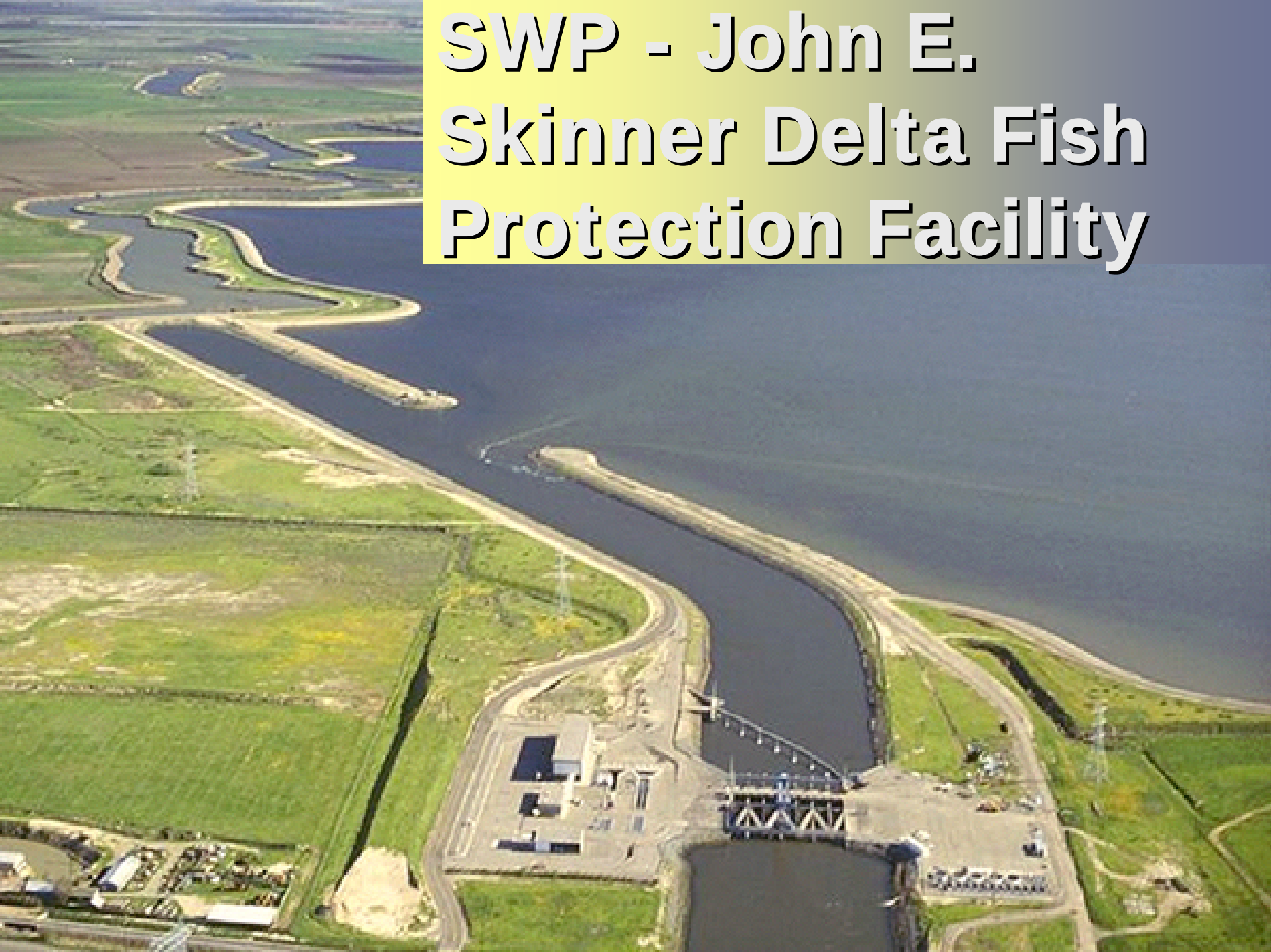
- Built in 1950‘s
- “Screens” 4600 cfs with Louvers
- Improvements mandated by CVPIA and B.O.’s
- CVPIA and CALFED studies on-going since 1993
- Designed for Salmon and Striped Bass
- Millions of Fish Salvaged Annually



# With Water Comes Fish and Debris…

# Louvers are Behavioral Screens…

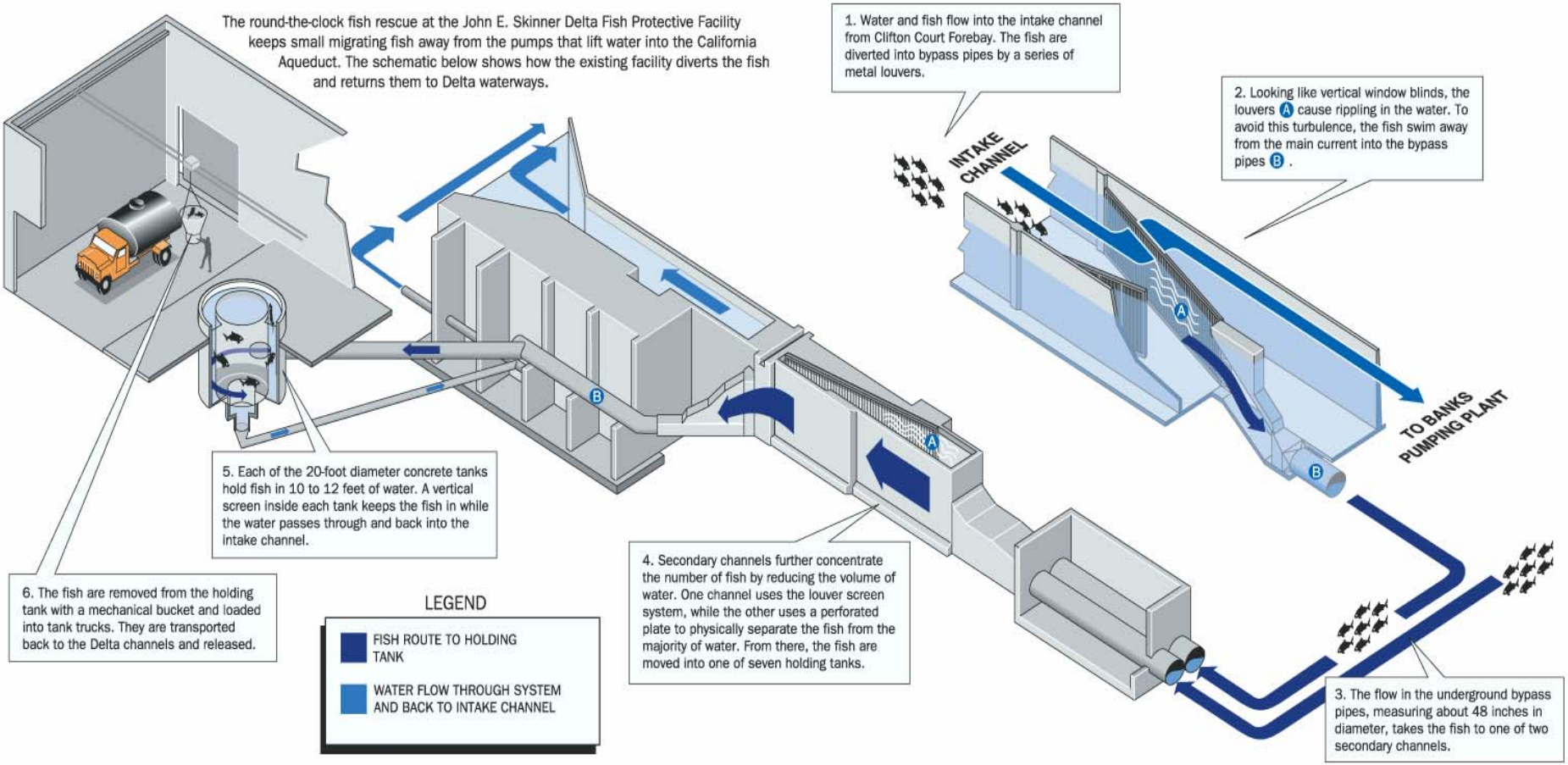


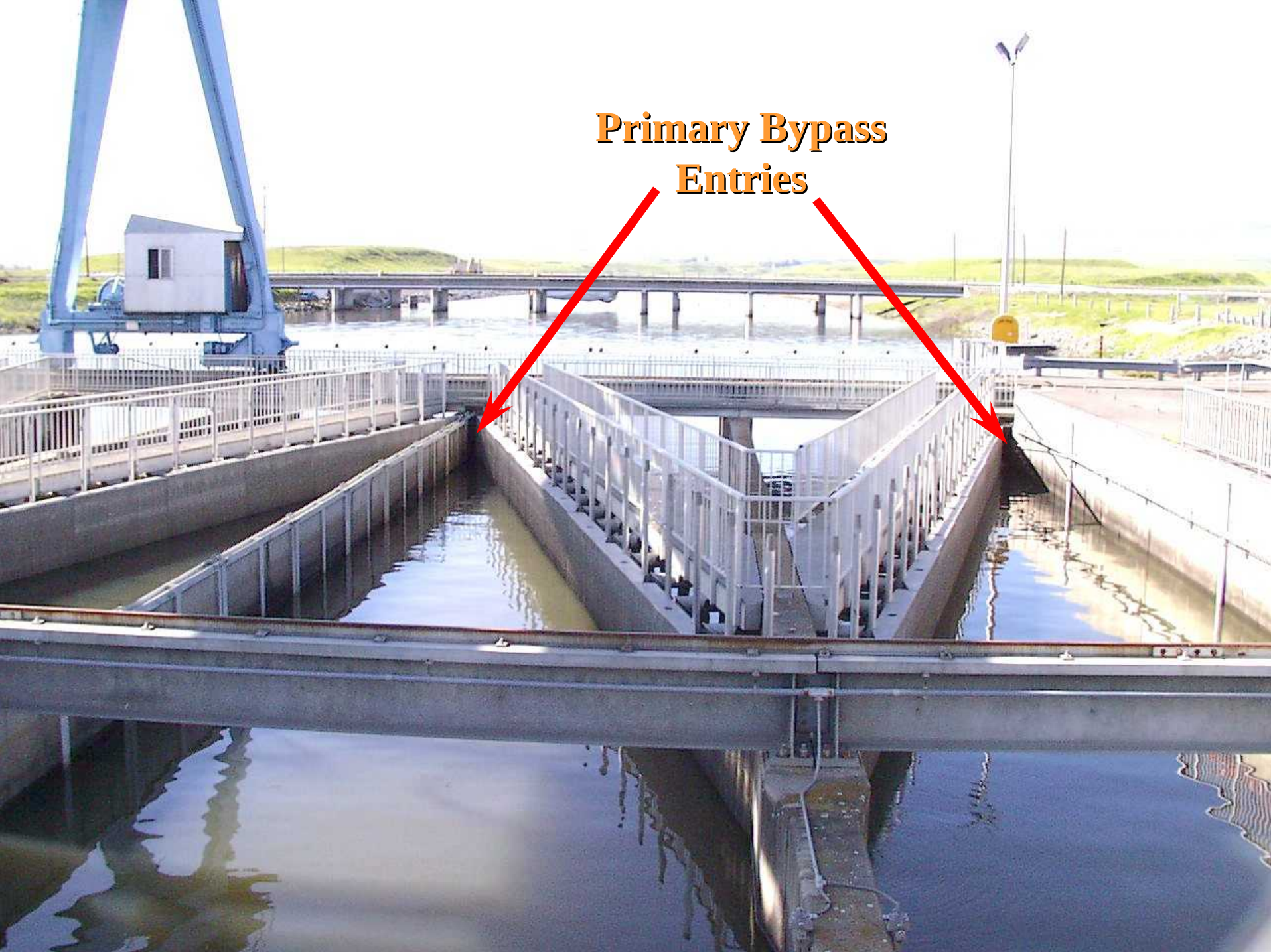

SWP - John E. Skinner Delta Fish Protection Facility


SWP

- Built in early 1970's
- "Screens" up to 10,300 cfs also with Louvers
- Multi-bay screen channels for improved hydraulic control
- Operates downstream of Clifton Court Forebay
- Millions of Fish Salvaged Annually

# Existing “Salvage” Process




Primary Bypass
Entries

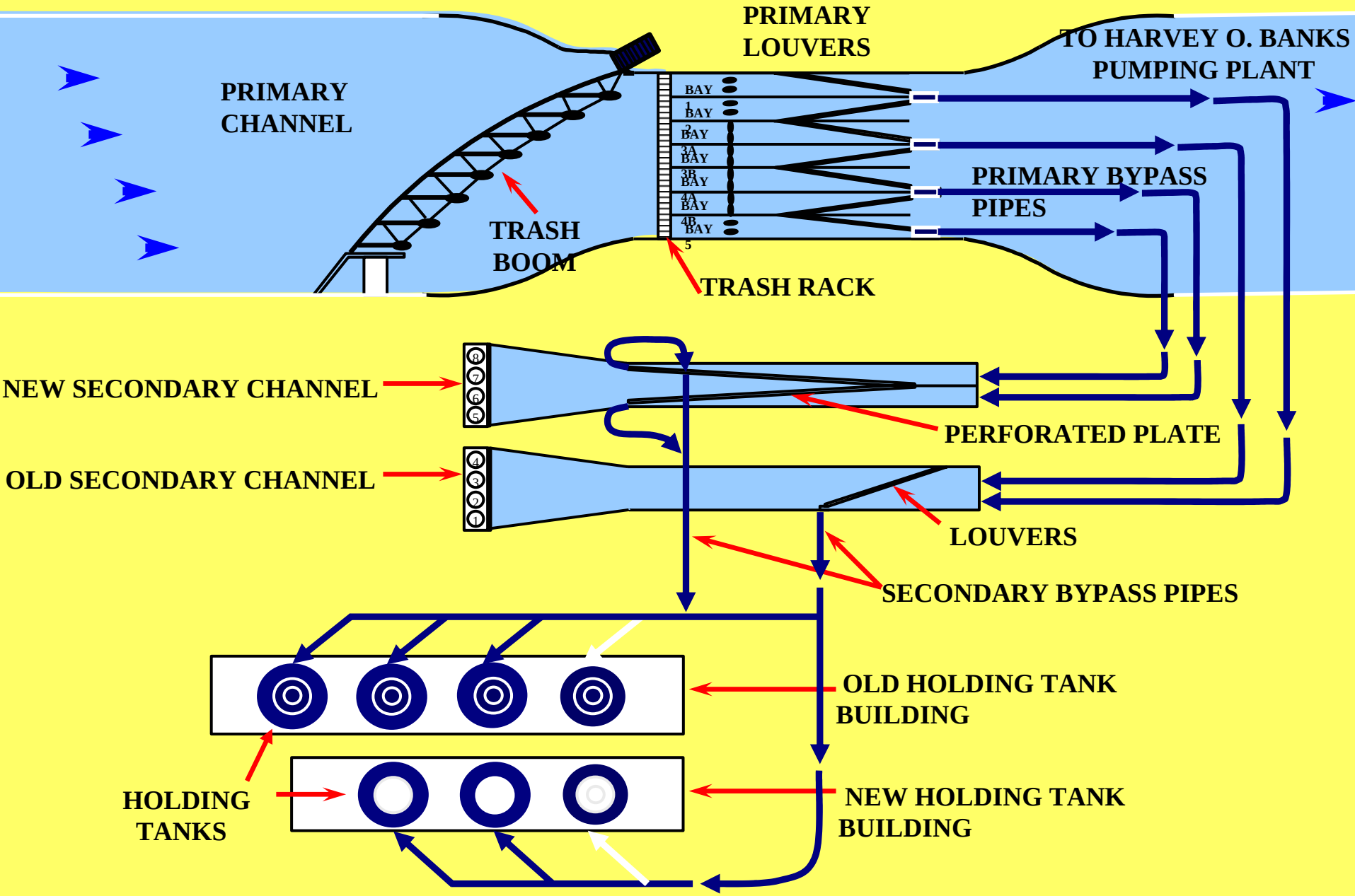
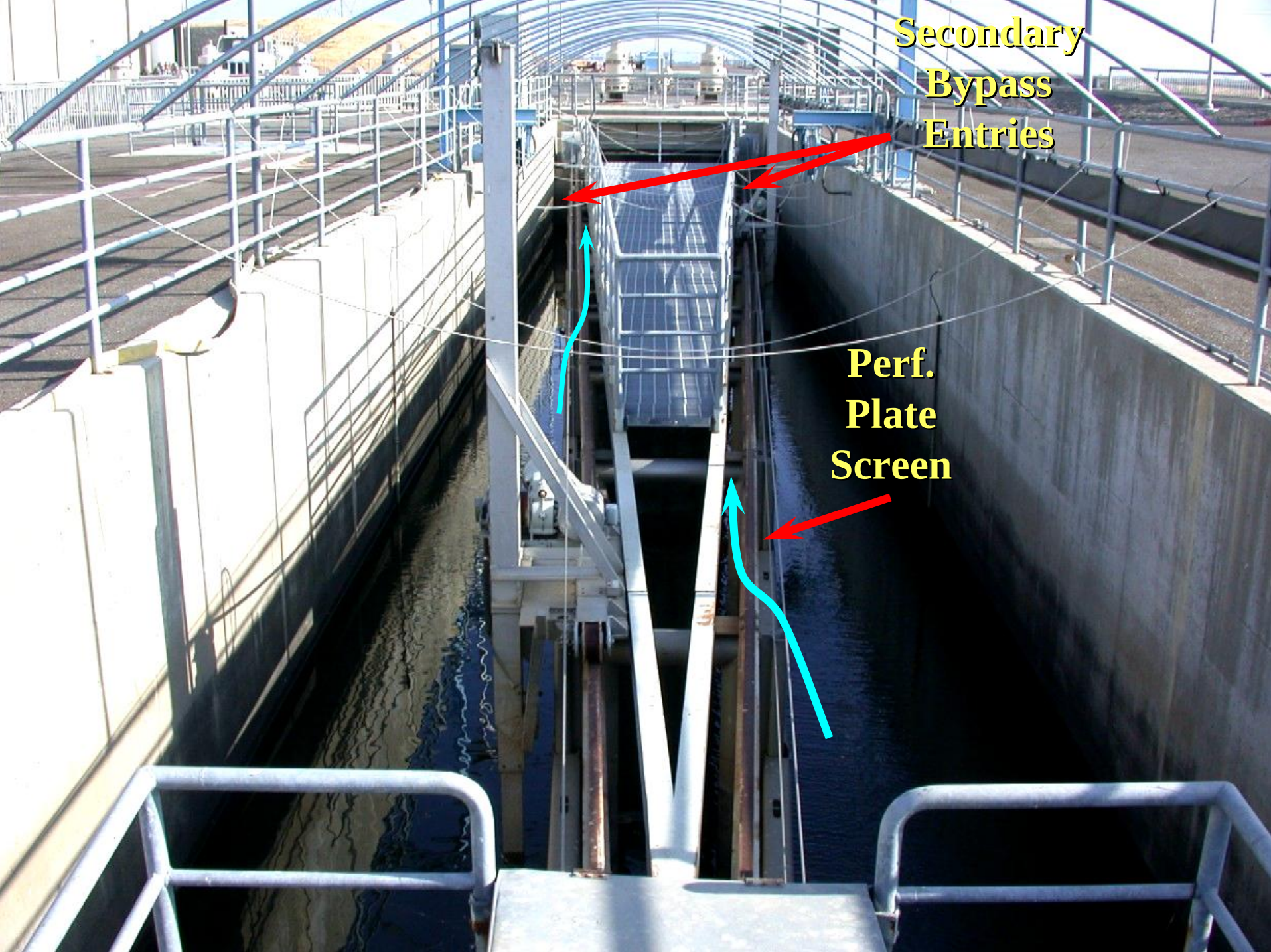
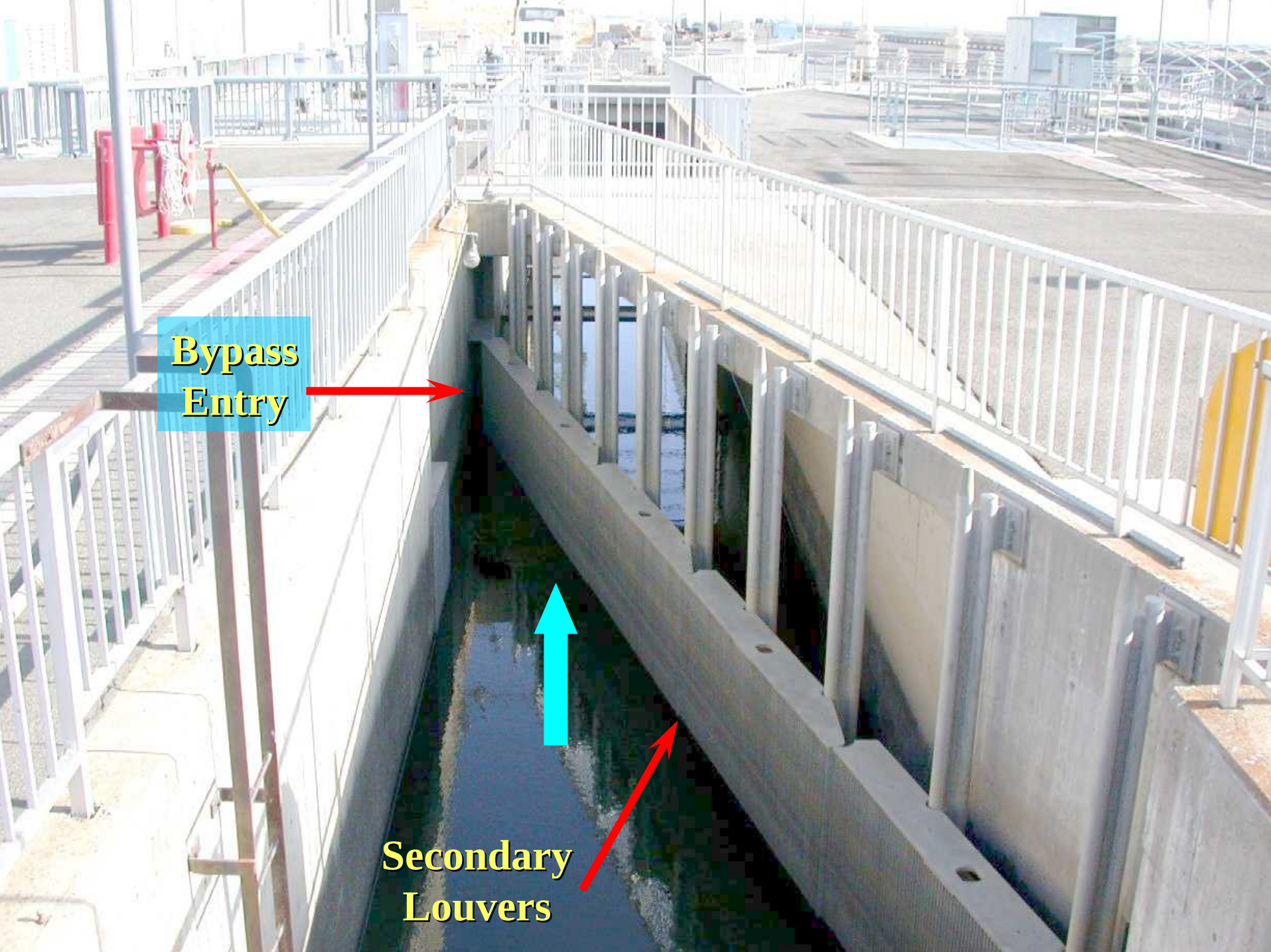
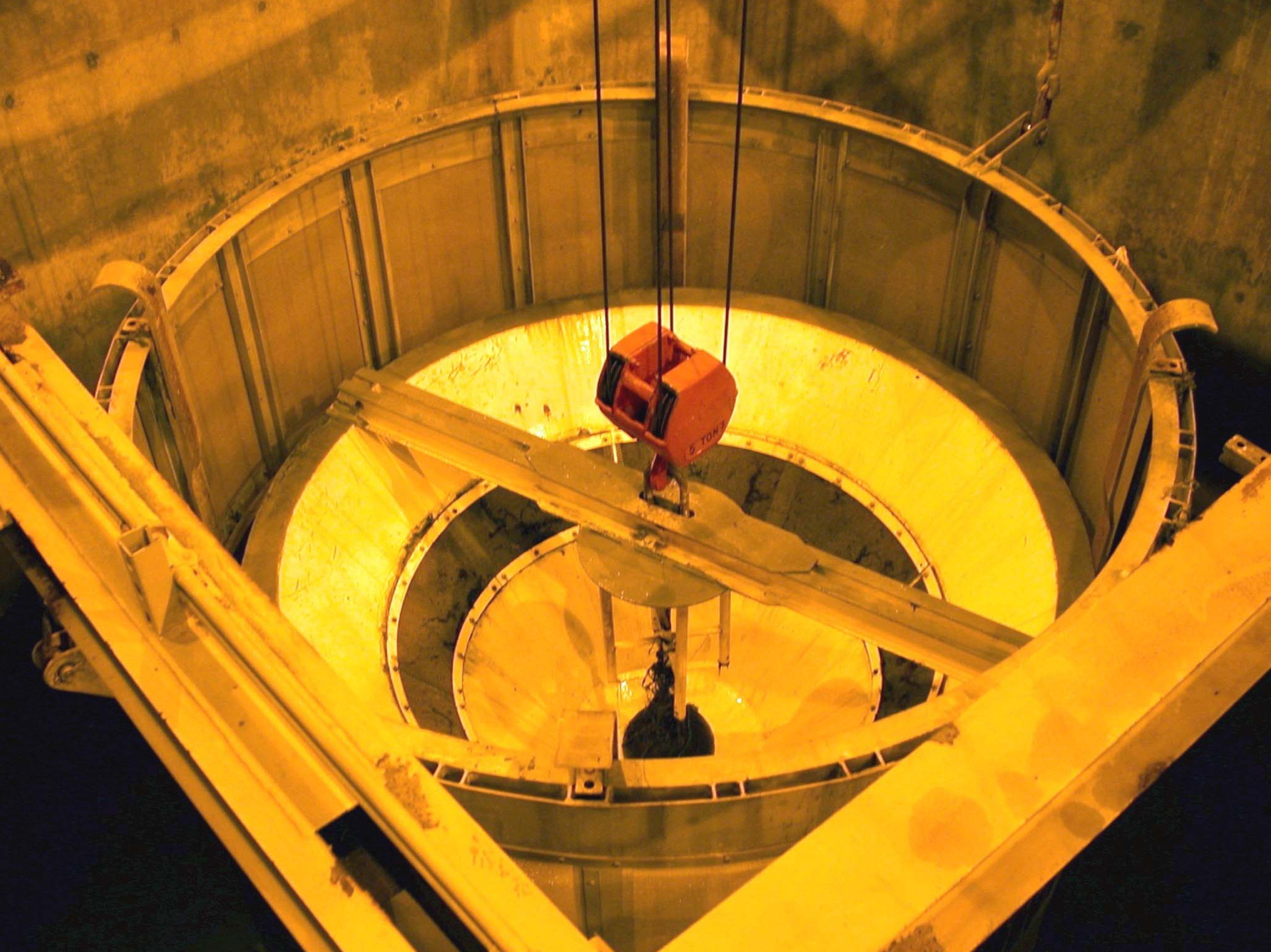



**Diagram of the John E. Skinner Delta Fish Protective Facility.**


Secondary
Bypass
Entries
Perf.
Plate
Screen


Bypass
Entry
Secondary
Louvers

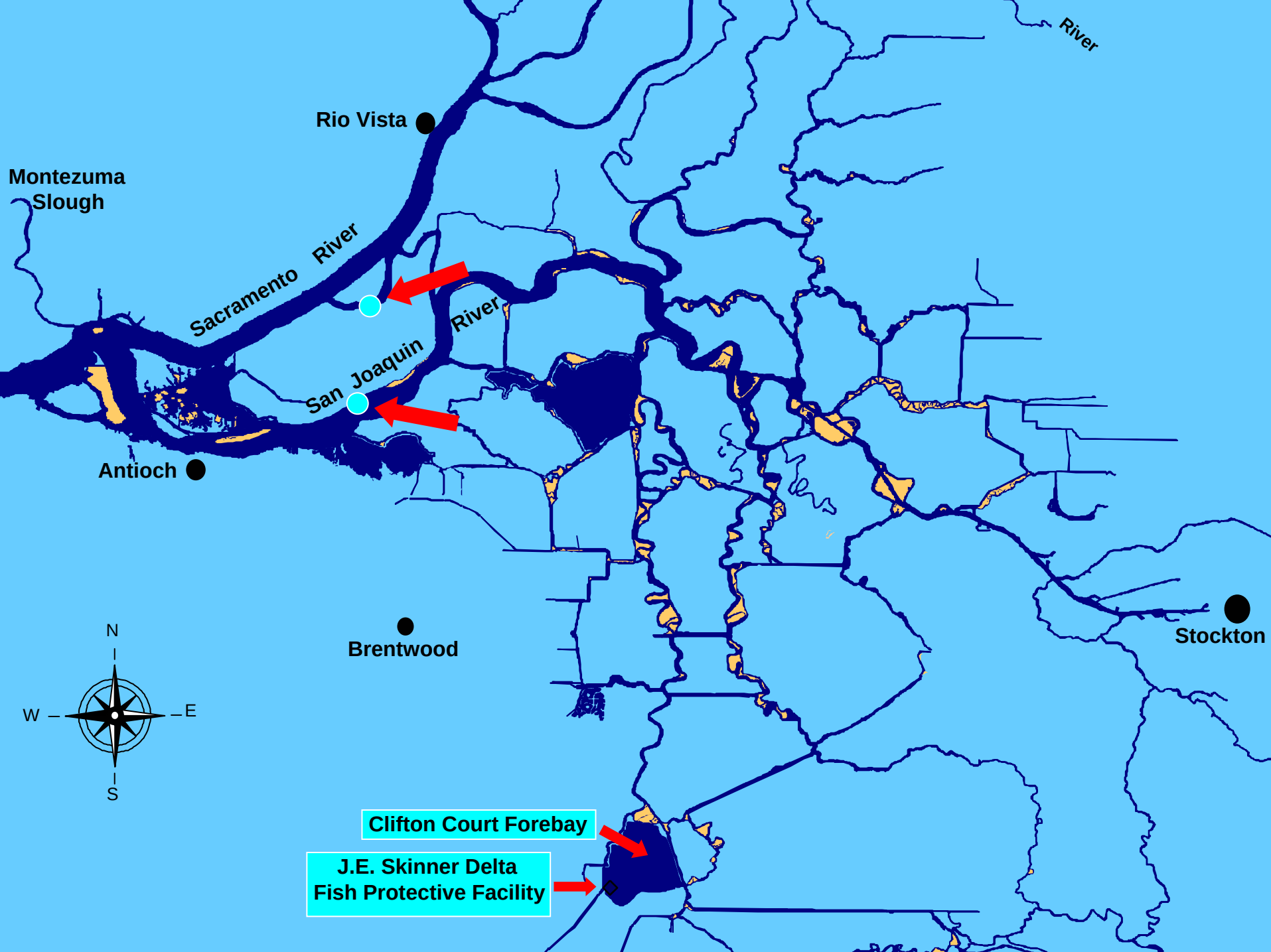


# Fish Salvage

- Approximately 40 to 50 different fish species are salvaged annually at the Skinner Fish Facility

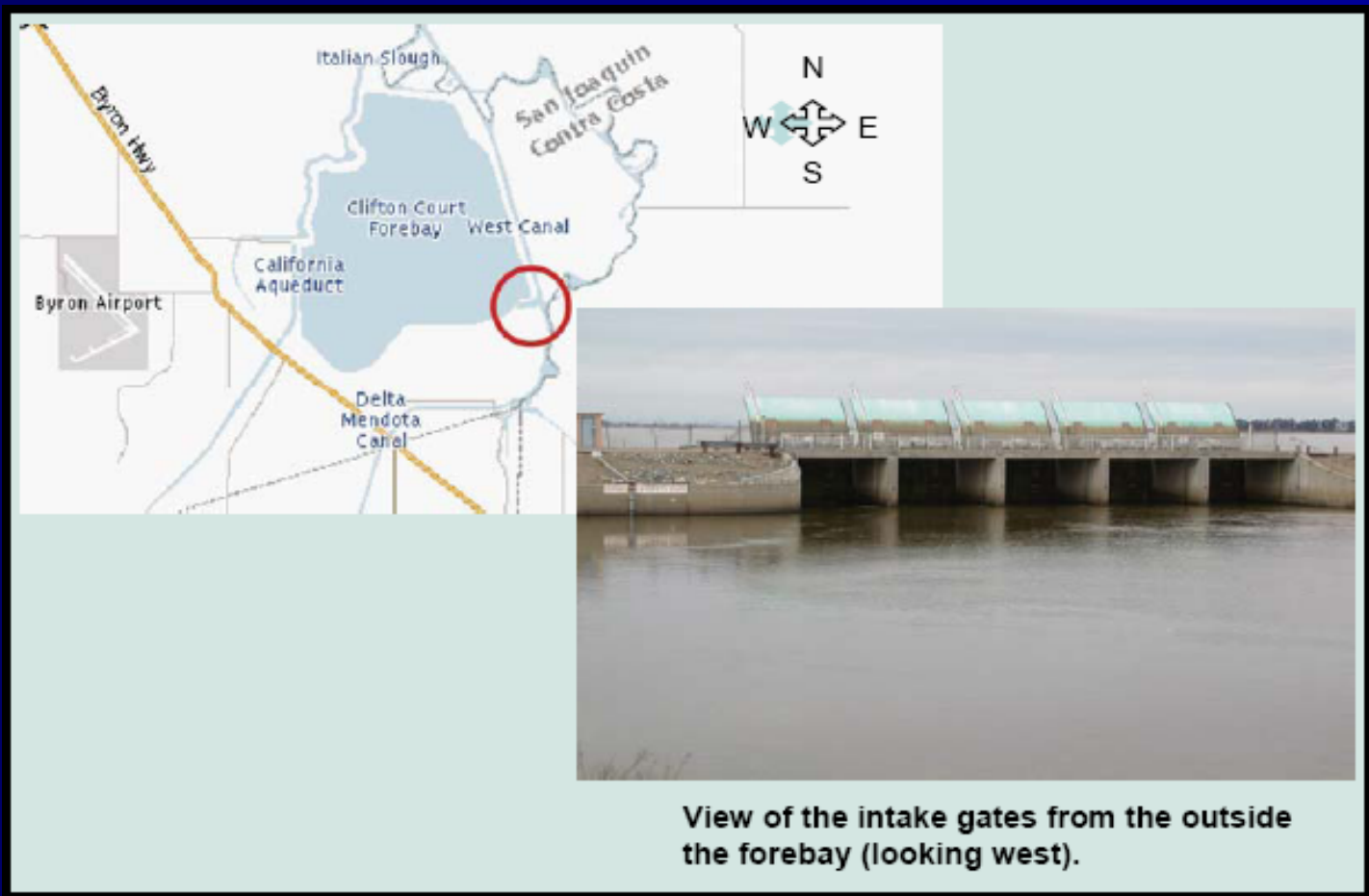
- Striped bass, threadfin shad, and American shad are the predominant fish species salvaged


WEST-MARK
WEST-MARK
WEST-MARK
WEST-MARK
01428


River
Rio Vista
Montezuma
Slough
Sacramento River
San Joaquin River
Antioch
Brentwood
Stockton
N
W
E
S
Clifton Court Forebay
J.E. Skinner Delta
Fish Protective Facility

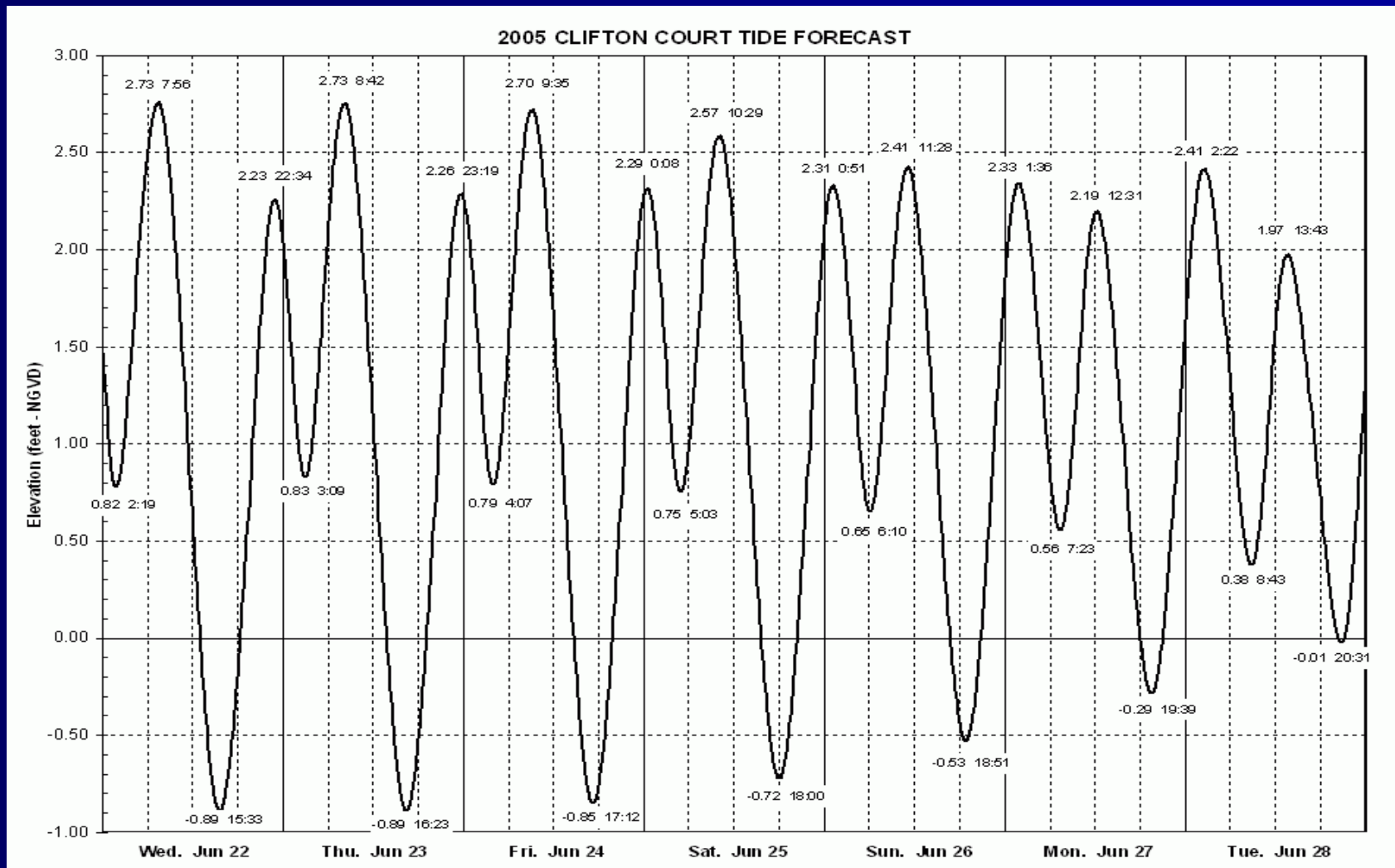
# Understanding CCF Operations

# CCF Forebay Allows Flexible SWP Pumping Operations and Reduces SD Water Level Impacts

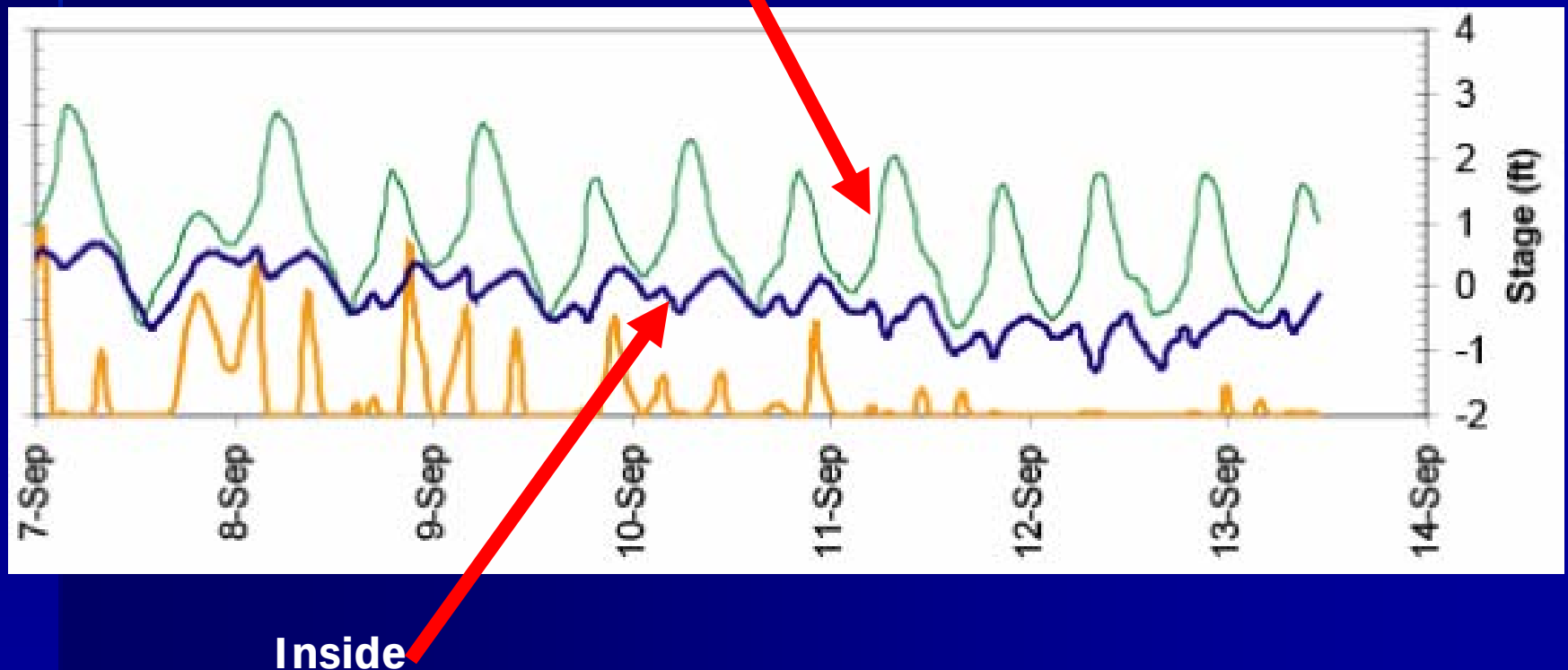



View of the intake gates from the outside the forebay (looking west).

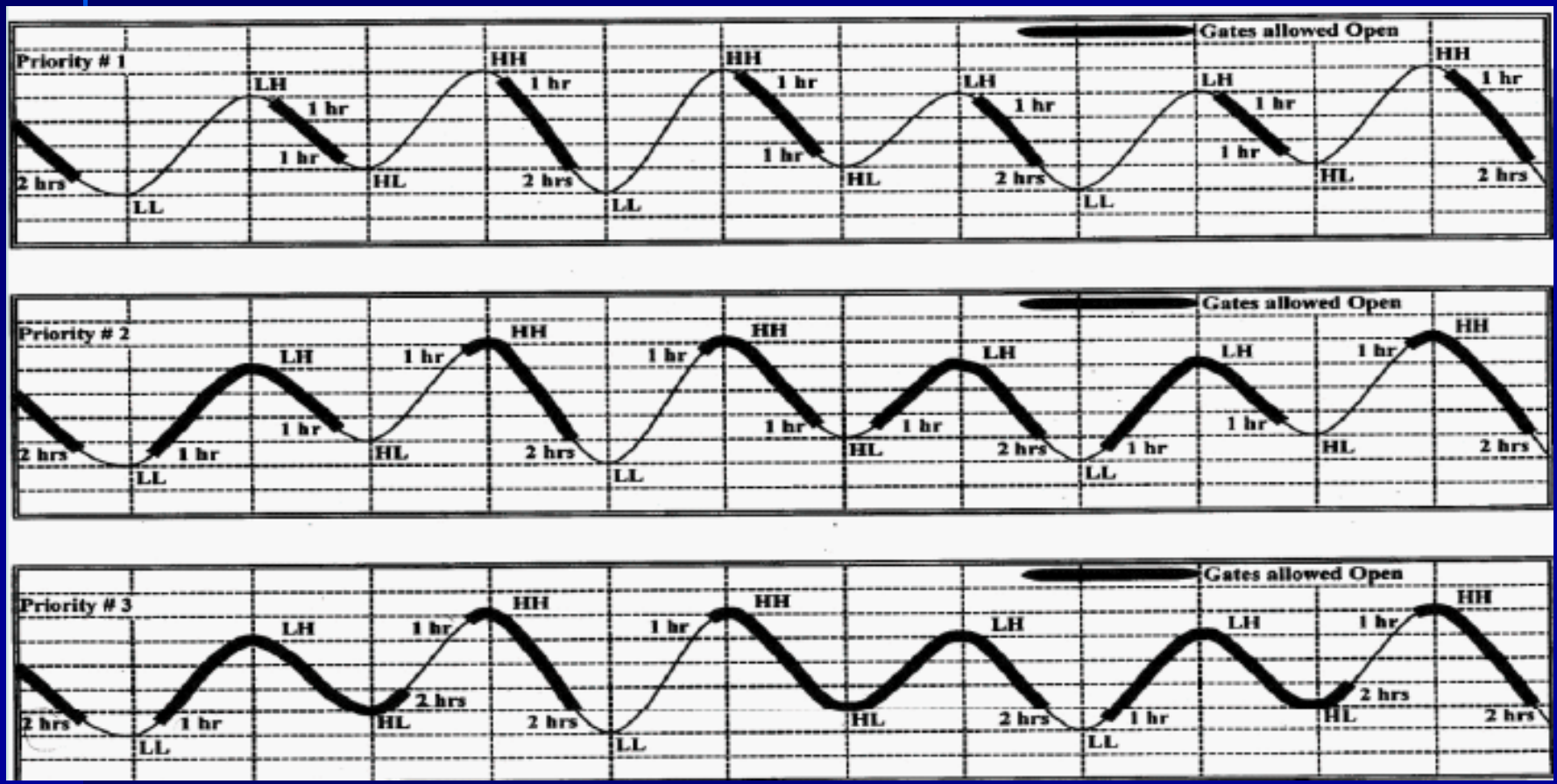
# Tidal Influences at CCF Intake



# CCF below Elev. -1 Can be Problematic to Pumping



# Priority CCF Gate Operations Dependant on South Delta Water Level Impacts



# Goal is to fill CCF with Water Allocation Each Day…Early

June 2004

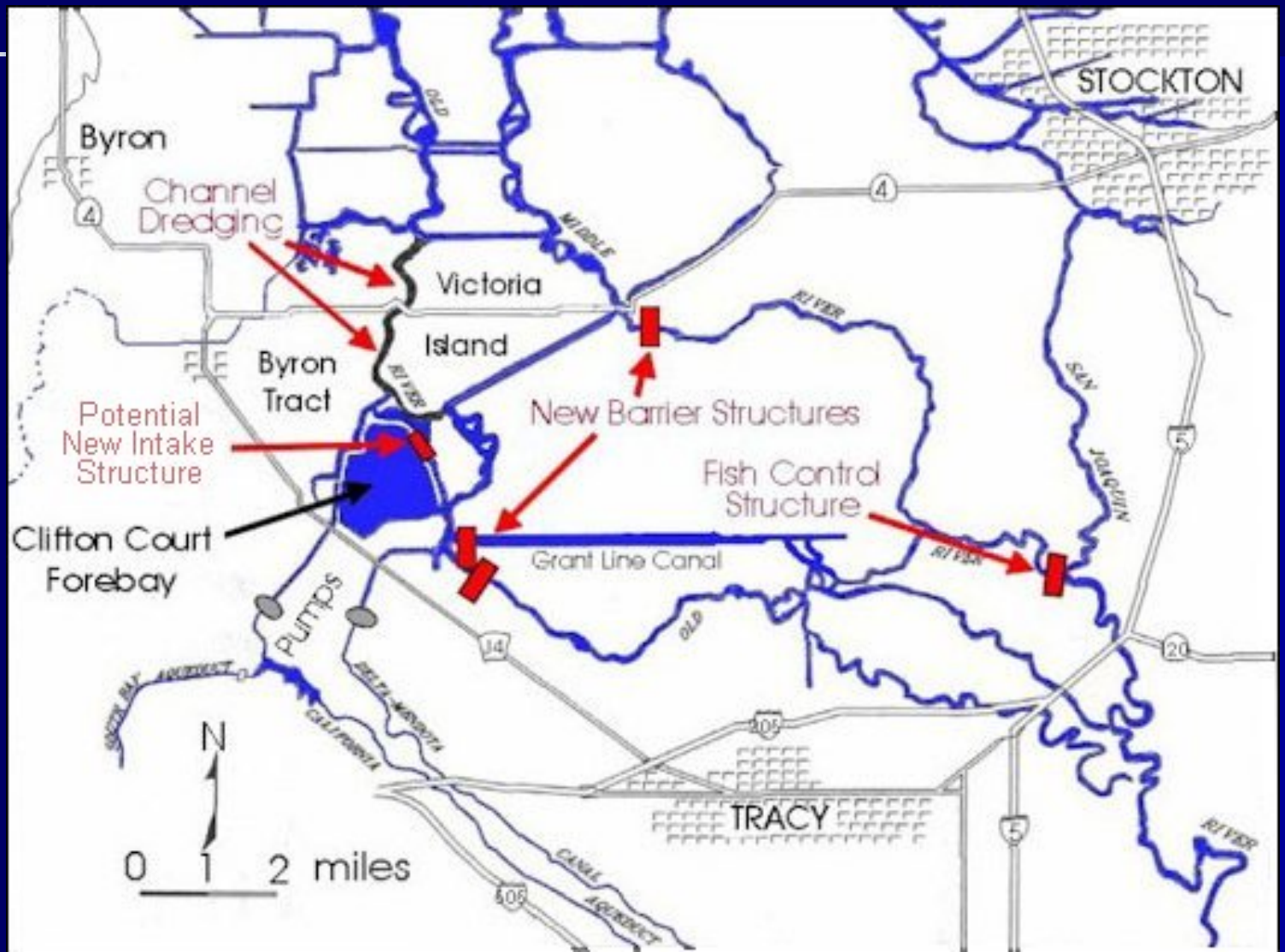
| Date | Time | | | | | | | | Amount of Inflow in Acre-Feet |
|---|---|---|---|---|---|---|---|---|---|
| | Opened | Closed | Opened | Closed | Opened | Closed | Opened | Closed | |
| 1 | 0:30 | 2:00 | 5:30 | 8:00 | 8:55 | 12:00 | | | 2,901 |
| 2 | 0:01 | 3:30 | 6:15 | 11:30 | | | | | 3,960 |
| 3 | 0:01 | 4:00 | | | | | | | 1,922 |
| 4 | 9:50 | 14:15 | 17:15 | - - - | | | | | 38 |
| 5 | - - - | 6:00 | 8:30 | 15:15 | | | | | 247 |
| 6 | 9:30 | 16:00 | 19:00 | 22:30 | | | | | 1,980 |
| 7 | 0:01 | 4:10 | | | | | | | 1,980 |
| 8 | 0:20 | 4:30 | 11:30 | 15:30 | | | | | 2,969 |
| 9 | 0:01 | 4:15 | 12:30 | 18:45 | 21:45 | - - - | | | 4,940 |
| 10 | - - - | 11:05 | 22:55 | - - - | | | | | 5,946 |
| 11 | - - - | 7:30 | | | | | | | 5,535 |
| 12 | 4:00 | 10:00 | 13:58 | 16:56 | | | | | 5,647 |
| 13 | 4:30 | 11:00 | 14:00 | 16:30 | | | | | 5,733 |
| 14 | 0:05 | 2:15 | 5:15 | 8:00 | | | | | 4,975 |
| 15 | 0:01 | 3:00 | 5:45 | 8:35 | | | | | 5,552 |
| 16 | 0:01 | 3:45 | 6:40 | 12:40 | | | | | 5,639 |
| 17 | 0:15 | 4:00 | | | | | | | 3,403 |
| 18 | 0:01 | 4:10 | 10:00 | 14:00 | | | | | 2,428 |
| 19 | 0:01 | 4:30 | | | | | | | 1,354 |
| 20 | 0:01 | 5:00 | 9:00 | 11:45 | | | | | 3,550 |

# At Higher Flows, gates can be opened almost all day…

- January 2004 Operations

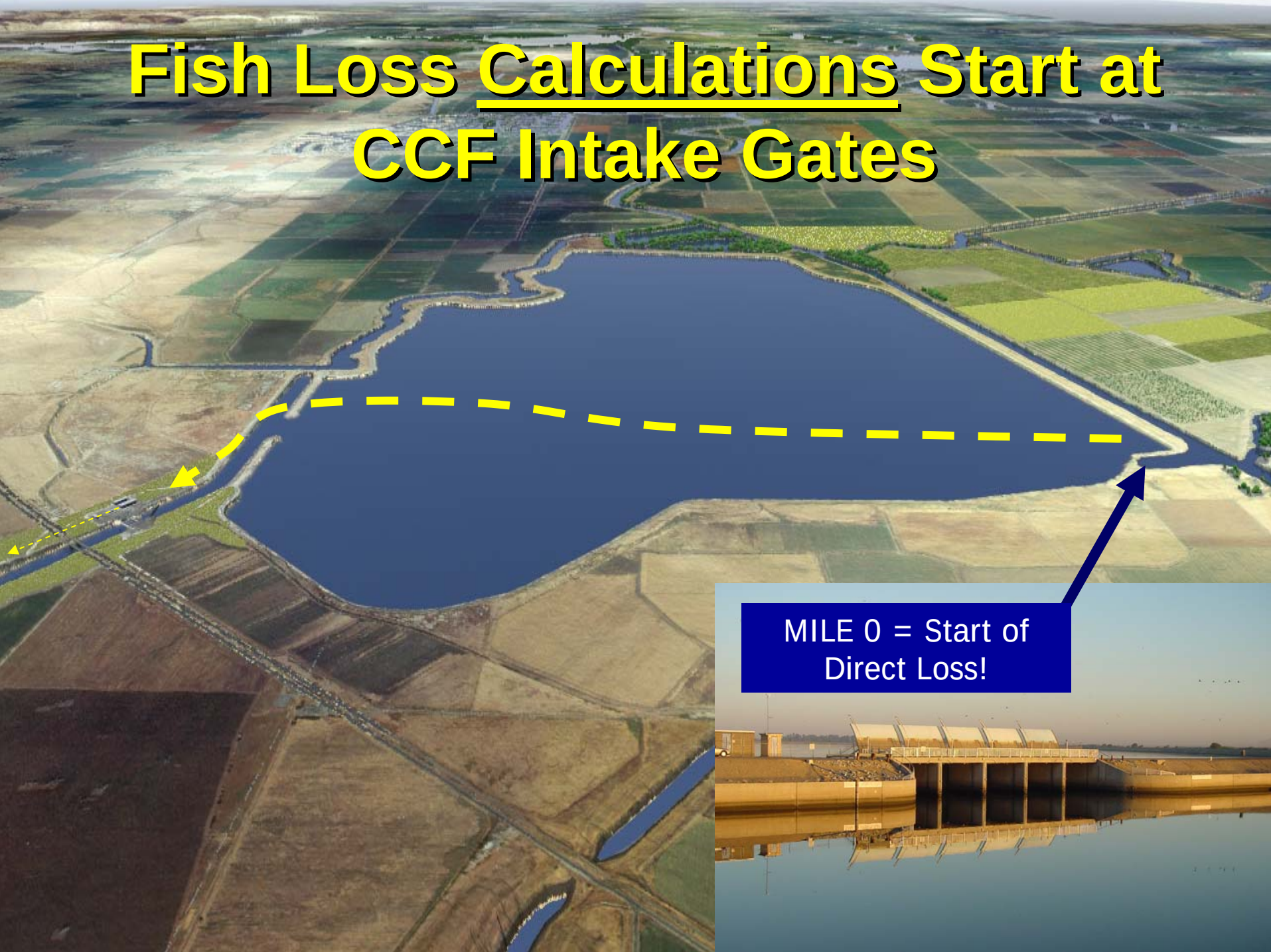
| Date | Time | | | | | | | | Amount of inflow in Acre-Feet |
|---|---|---|---|---|---|---|---|---|---|
| | Opened | Closed | Opened | Closed | Opened | Closed | Opened | Closed | |
| 22 | 0:01 | 0:30 | 3:30 | 16:15 | 18:45 | 23:20 | | | 14,233 |
| 23 | 0:01 | 1:15 | 4:15 | 17:15 | 19:45 | 23:00 | | | 14,218 |
| 24 | 0:01 | 2:00 | 5:00 | 18:00 | 20:30 | 23:15 | | | 14,214 |
| 25 | 0:01 | 2:45 | 5:45 | 19:00 | 21:15 | - - - | | | 13,879 |

# Barriers Influence Hydraulics to Export Facilities and Minimize Water Level Impacts to SD Irrigators



# Fish Loss Calculations

# Fish Loss Calculations Start at CCF Intake Gates



# Pre-Screen Losses at CCF

*Current Assumptions From 4-Pumps Negotiations*

- **Predation = 75% of juvenile fish entering**
  - **Based on juvenile salmon experiments**
  - ***However*, mean of all tests > 85%**
- **No changes with temperature**
  - ***However*, temperature appears to be a factor**
- **No changes with pumping rate**
  - ***However*, losses vary inversely with pumping rate**
- **Predation is comparable for other species**
  - ***However*, data for striped bass and salmon only**

# SWP Loss Calculations - Chinook

## App. A, CDFG Operating Agreement, CCF Salvage Ops.

- **Expand 10-minute count ($C_{EXP}$) *e.g.* = 100**
- **Correct for louver efficiency ($E_L$)**
  - **$E_L$ = 0.586 + 0.0579*Vel.**
  - **For Vel. = 3.0 fps, $E_L$ = 0.742**
  - **Fish encountering screens: $C_{EXP}$ / $E_L$ = 135**
- **Correct for Pre-Screen Losses (CCFB predation)**
  - **Ent. = $C_{EXP}$ / (1- 0.75) $E_L$ = 539**
- **Correct for Handling, Trucking Loss ($L_H$; $L_T$)**
  - **Alive = $C_{EXP}$ (1 - $L_H$) (1 - $L_T$) = 96**
- **System Loss ($L_{SYS}$)**
  - **$L_{SYS}$ = Ent. - Alive = 441; System Survival = 17.8%**

# CVP LossCalculations - Chinook

## NMFS Biological Opinion (1993)

- Expand 10-minute count ($C_{EXP}$) *e.g.* = 100
- Correct for louver efficiency ($E_L$)
  - $E_L$ = 0.586 + 0.0579*Vel.
  - For Vel. = 3.0 fps, $E_L$ = 0.742
  - Fish encountering screens: $C_{EXP}$ / $E_L$ = 135
- Correct for *Assumed* Pre-Screen Losses
  - Ent. = $C_{EXP}$ / (1- 0.15) $E_L$ = 142
- Correct for Handling, Trucking Loss ($L_H$; $L_T$)
  - Alive = $C_{EXP}$ (1 - $L_H$) (1 - $L_T$) = 96
- System Loss ($L_{SYS}$)
  - $L_{SYS}$ = Ent. - Alive = 43; System Survival = 67.6%

# Predators Come in all Sizes…